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AUTHOR DelForge, Clarence; Clark, J. Milford
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ABSTRACT

In 1976, students in the fourth, fifth, and sixth grades in a multigraded classroom who had evidence low mathematics scores on the Iowa Test of Basic Skills were selected to work on the Hewlett-Packard mathematics program for 10 minutes each day on a classroom computer. The higher performing students (the upper 55% of the class) were selected as a control grup and worked on the computer program for only 10 minutes per week. The experimental group showed project. A follow-up study of the performance rate of both groups on the North Carolina Competency Test in Mathematics was conducted when the students were in their eleventh-grade year: 35 of the original 51 students participated. The pass rate of students in the experimental group was significantly higher than that of students in the control group. (KM)

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Effects of CAI Mathematics on Student Performance:

A Nine Year Longitudinal Study

Clarence DelForge, Associate Professor
Department of Elementary Education and Reading
School of Education and Psychology
Western Carolina University
Cullowhee, North Carolina 28723

J. Milford Clark, Associate Dean
School of Education and Psychology
Western Carolina University
Cullowhee, North Carolina 28723

Proofs and reprint requests should be sent to:

Clarence DelForge, Associate Professor
Department of Elementary Education and Reading
School of Education and Psychology
Western Carolina University
Cullowhee, North Carolina 28723

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Abbreviated Title

Effects of CAI Mathematics on Student Performance

Abstract

Students in the fourth, fifth, and sixth grades in a multigraded classroom who had evidenced low mathematics scores were selected to work on the Hewlett-Packard mathematics program for ten minutes each day on a classroom computer. The higher performing students were selected as a control group and worked on the computer program for only ten minutes per week. The experimental group showed significantly higher gains in mathematics during the two years of the project. A follow-up study of the performance rate of both groups on the North Carolina Competency Test in mathematics was conducted when the students were in their eleventh grade year. The pass rate of students in the experimental group was significantly higher than that of students in the control group.

Effects of CAI Mathematics on Student Performance:

A Nine Year Longitudinal Study

In the fall of 1976 a computer terminal was installed in the open, multigraded classrooms of the fourth, fifth, and sixth grades at Log Cabin Elementary School in Jackson County, North Carolina as a part of a Teacher Corps project. Teacher Corps, the Jackson County Schools, and the Department of Elementary Education at Western Carolina University wanted to determine if CAI mathematics would make a significant difference in student achievement in mathematics as measured by a standardized achievement test. Through the facilities of the North Carolina Educational Computing Services, located in the Research Triangle Park 300 miles away, the Hewlett-Packard mathematics program was used in this study.

Students who had evidenced low mathematics scores on the Iowa Test of Basic Skills (approximately 45 percent of the class) were selected to work on the computer daily for a maximum of ten minutes as a supplement to their regular mathematics instruction. The upper 55 percent of the class were scheduled once a week for a maximum of ten minutes. Time on the computer was scheduled so that no student missed any of the regular mathematics instruction by the teacher, otherwise, the computer was in continuous use by the students.

The CAI mathematics program used was individualized for each student. Prior to beginning to work on the computer, students' performance levels were diagnosed and each student was started in the

program at a level where he/she was successful. The teacher received a weekly report of each student's progress and followed up with additional instruction based on the report. The program was, thus, personalized for each student.

After 14 hours of CAI mathematics instruction the lower 45 percent gained one year and one month in mathematics achievement on the Iowa Test of Basic Skills. The upper 55 percent of the class showed a gain of only eight months. The experimental group was compared to a matched control group at Scotts Creek Elementary School, another school within Jackson County. The control school was in the adjoining attendance area. Although it was larger the control school served a student body much like that of the experimental school. The socio-economic levels of the communities were much the same, school facilities and materials were similar, and the mathematics curriculum was the same. The results were that the experimental group scored significantly higher in achievement than the control group. The control school had always scored higher on achievement tests than the experimental school.

The study was repeated the following year using the same students from grades four and five who were now fifth and sixth graders. The previous year's third grade students moved into the program as fourth graders. Students in the matched control school were changed accordingly. Similar results were found for student achievement at the end of the 1977-78 school year.

A follow-up study of the students in the experimental groups at Log Cabin Elementary School and the control group at Scotts Creek School was conducted during the eleventh grade to compare their performance on

the North Carolina Competency Test of Mathematics to determine if CAI mathematics instruction made a difference in performance on that test. The North Carolina test is a basic mathematics competency test which students must pass to graduate from high school. Students first take the test during the eleventh grade. Students who fail the test may retake it.

The follow-up study looked at the long term effects of CAI mathematics instruction indicated by the pass/fail rates of students in the original experimental and control groups at both Log Cabin Elementary School and the matched, control group at Scotts Creek Elementary School.

Procedures

Students who participated in the 1976-77 and 1977-78 experimental and control groups were identified according to their graduating class (1983, 1984, 1985, 1986). The number of students from the study who remained in the school district, and were available for the follow-up, had declined considerably for the both the experimental and control groups for each graduating class. The remaining numbers were small.

Those who were still in the school district from both groups were compared on the basis of their pass/fail rate on the North Carolina Competency Test of Mathematics to determine if there was a significant difference between the groups on their performance. Since the numbers were small, a chi square analysis testing for the significance of difference between proportions was utilized in analyzing the data. A chi square value was computed for each group by graduating class as

well as for the total group of students involved in the study. The .01 level of significance was used as the critical value in all analyses. A phi coefficient was derived from the chi square statistic to indicate the level of correlation between the variables.

When interpreting the data it was also necessary to take into consideration that there was a difference in the total amount of time spent in CAI instruction among the experimental groups from one year to another. The fourth and fifth graders who were in the study the first year received a total of 39 hours of CAI instruction during their two years as a part of the experimental group (14 hours the first year and 25 hours the second year). The sixth graders who were in the study the first year moved into the seventh grade and out of the study during its second year. They received a total of 14 hours of CAI instruction. During the second year of the study a new fourth grade group moved into the study and received a total of 25 hours of instruction that year. All students from both the experimental school and the matched control school attended the same high school.

Findings

A total of 35 students remained in school through the eleventh grade from the original pool of 51 students who made up the experimental and control groups. The chi square analysis of proportions on the total group of 35 students who took the competency test in the eleventh grade indicates that there is a significant difference between the performance of students on the test who were in the experimental group and the students who were in the control group.

No students in the experimental group failed the test, while 7 out of 21 in the control group failed. This is significant at the .01 level. A phi coefficient of .44 verifies the validity of this finding. Table 1 contains the analysis of data for the total group.

Since there were no failures in the experimental group, one might expect to find a significant difference in performance based on the analysis of year-by-year groups of students involved in the study. This is true for groups taking the test in 1984, 1985 and 1986. A significant difference in performance does exist at the .01 level. Phi coefficients for each of these years also verify validity of these findings. However, there were no failures for either the experimental or control group in 1983. There obviously was no difference in their pass/fail rate and a chi square value could not be calculated. Year-by-year data and the analysis of that data for each group is presented in Tables 2-5.

An analysis of drop-out rates for students in each group was also performed. A total of 16 students from the original pool of 51 dropped out of school prior to the eleventh grade. Nine students from the experimental group and seven from the control group dropped out. A chi square analysis of proportions on these data for the total group indicates that no significant difference exists between the groups on the drop-out rate. The same is true on a year-by-year analysis of the drop-out data. The analysis of the drop-out data for the total group is presented in Table 6.

There were other findings which may impact on the interpretation of

Table 1

Analysis of Proportion of Students in Experimental and Control Groups

Passing/Failing State Math Exam 1983-1986

		Experimental Group	Control Group
Performance on State Math Exam	Pass	14 (100)	14 (67)
	Fail	0 (0)	7 (33)

Chi Square = 37.16 $P < .01$

Phi = .44

Table 2

Analysis of Proportion of Students in Experimental and Control Groups Passing/Failing State Math Exam in 1983*

		Experimental Group	Control Group
Performance on State Math Exam	Pass	4 (100)	3 (100)
	Fail	0 (0)	0 (0)
		Chi Square = 0	P < .01
		Phi = 0	

*Participated in the study for one year for a total of 14 hours of CAI mathematics instruction.

Table 3

Analysis of Proportion of Students in Experimental and Control Groups Passing/Failing State Exam in 1984*

		Experimental Group	Control Group
Performance on State Math Exam	Pass	3 (100)	5 (71)
	Fail	0 (0)	2 (29)

Chi Square = 31.61 $P < .01$

Phi = .41

*Participated in the study for two years for a total of 39 hours of CAI mathematics instruction.

Table 4

Analysis of Proportion of Students in Experimental and Control Groups Passing/Failing State Math Exam in 1985*

		Experimental Group	Control Group
Performance on State Math Exam	Pass	4 (100)	3 (50)
	Fail	0 (0)	3 (50)

Chi Square = 64.02 $P < .01$

Phi = .57

*Participated in the study for two years for a total of 39 hours of CAI mathematics instruction.

Table 5

Analysis of Proportion of Students in Experimental and Control Groups Passing/Failing State Math Exam in 1986*

		Experimental Group	Control Group
Performance on State Math Exam	Pass	3 (100)	3 (60)
	Fail	0 (0)	2 (40)

Chi Square = 47.53 $P < .01$

Phi = .50

*Participated in the study for one year for a total of 25 hours of CAI mathematics instruction.

Table 6

Analysis of Drop-out Rates of Students

in Experimental and Control Groups

1983-1986

	Experimental Group	Control Group
Dropped Out	9 (39.1)	7 (25.0)
Remained in School	14 (60.9)	21 (75.0)

Chi Square = .60 P< .80

Phi = .11

the results of the study. No students in either group took any mathematics classes other than the minimal number required to graduate from high school. Both groups made only low to average grades in their general mathematics course in high school. Twelve students, five from the experimental group and seven from the control group, enrolled in a computer course in high school. There is no significant difference indicated in these numbers. A summary of these data and other data analyzed in this study are found in Table 7.

Conclusions

The analysis of the data in this study does indicate that CAI mathematics instruction at the 4th, 5th, and 6th grades for students at the lower performance levels does have a long term effect on their performance in mathematics. The effect on this performance on competency tests is significant. Early intervention with CAI mathematics instruction for lower achieving students does not appear to positively affect other variables associated with this study. The student dropout rate and enrollment in higher level mathematics courses were not affected. Student performance in mathematics courses as measured by grades received was likely affected by CAI instruction although not significantly. Student grades in mathematics courses continued to be low to average in high school. However, this study did not propose to analyze results of student performance in mathematics courses.

Due to the small number of students in this study, the conclusions drawn should be considered only positive indications. Studies with larger numbers of students should be conducted to see if their findings

Table 7

Results of Nine Year Longitudinal Study

	Class of 1983		Class of 1984		Class of 1985		Class of 1986	
	Experimental Group	Control Group	Experimental Group	Control Group	Experimental Group	Control Group	Experimental Group	Control Group
Passed State Math Test	4	3	3	5	4	3	3	3
Failed State Math Test	0	0	0	2	0	3	0	2
Enrolled in Computer Class	1	1	3	4	0	1	1	1
Moved from School District	3	2	2	3	3	3	2	2
Dropped Out	1	4	4	1	2	1	2	1

support those found here. In the 1970's there were not many computer projects in place around the country. However, Title I did fund several large CAI projects. It would be of value if students in these projects could be followed up to determine if the findings in this study would hold for large numbers of students.

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